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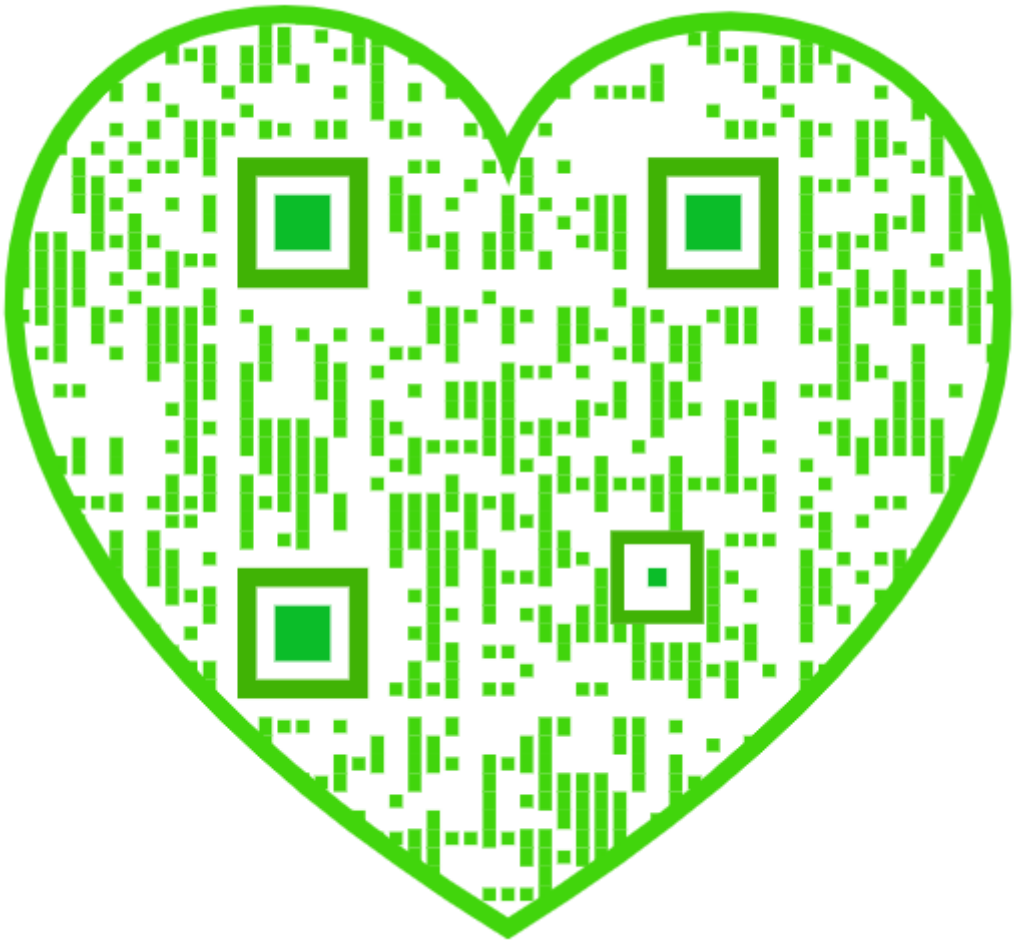

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MONEY MAKING FOR WOMEN

COMPLETE GUIDE

SILK CULTURE.

L. CAPSADELL.

W.B. SMITH & CO. NEW YORK.

27 Bond St.

GATHERING MULBERRY LEAVES.

THE

COMPLETE GUIDE

TO

SILK CULTURE.

BY

L. CAPSADELL,

Secretary New York Silk Exchange.

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PREFACE.

Without sacrificing comprehensiveness to brevity this book aims to be a concise, practical, and reliable manual in every detail of silk-culture.

French, Italian, and English authorities on the subject are discursive and elaborate; early American authorities were premature, and are outgrown by experience; and recent American publications have been generally mere business circulars and pamphlets issued simply for advertising purposes.

Diligent research and most careful effort have been made to discriminate, for this volume, the best data and the soundest results of modern experiments, and to bring them within an intelligent focus.

TO SILK-CULTURISTS.

It is reasonably believed that no culturist, however young as a beginner, or however skilful as an expert, will need any other instruction than that which is comprised within these pages, in order to acquire the largest profits and to retain the best permanent successes in American silk-culture.

TO PRINCIPALS AND OFFICERS OF SCHOOLS.

The method and practice of silk-culture are taught in all the schools of France, from the primary to the grammer grades, in the convents, and in all the high schools. All classes are taught its simplicity, usefulness, necessity, and profit.

There is no industry in the world which can be made so generally universal and so immensely profitable as silk-culture.

From the feeding of the worms to the weaving of braids and ribbons and the knitting of hosiery, it can be conducted very economically and be made to yield an almost fabulous income.

Why should it not be introduced as a study in American schools?

TO TEACHERS.

This volume is confidently presented as a text-book which will enable you to introduce and teach this new study immediately. With the aid of the book the subject is easily available, interesting, pleasant and practicable; and it can be taught within a single school term of fourteen weeks.

HOW TO USE THE "GUIDE" AS A TEXT-BOOK

1. As a supplementary reading book in the higher grades of primary classes.

2. As a recitation book in the intermediate and grammar classes.

3. Turn the topical or black-letter section-heads into questions. The topics are thus marked, throughout the book, expressly for this purpose.

L. CAPSADELL.

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NOTE.

The author of this book is under obligations for assistance rendered in its preparation by Mr. VIRION DES LAURIERS, the Superintendent of the New York Silk Exchange and an experienced silk-culturist.

L. C.

NEW YORK, Oct. 7, 1882.

GUIDE TO SILK-CULTURE.

I.

SILK-PRODUCING FOODS, AND HOW TO RAISE THEM.

SPECIES.

The Mulberry-tree was cultivated in China, and known by the name of *The Golden Tree*, two thousand six hundred years before the Christian era.

The silkworm requires a food comprising four substances,—a fibrous substance, water, saccharine, and resin. Water and saccharine nourish the worm: the resinous substance gives the silk.

Good foods comprising the above qualities are given below, and are valuable in the order named.

1. White Mulberry (*Morus Japonica*).
2. " " (*Morus Alba Moretti*).
3. " " (*Morus Alba Rosea*).
4. " " (*Morus Alba proper*).
5. " " (*Morus Multicaulis*).
6. Black " (*Morus Nigra*).
7. Caucasian " (*Morus Tartarica*).
8. Osage Orange (*Maclura Aurantiaca*).

Morus Japonica is Japanese,—the Lou Sang. In France, Italy, and Spain, nearly all other trees have been discarded for this. It produces more silk

than any other variety, and grows in more convenient shape and height for gathering its leaves. It is hardy, stands severe winters, and while it is the best for the Eastern, Western, and the Middle States, it is equally well suited for all the Southern States. It has a large leaf, comes early, and yields one pound of cocoons to about ten pounds of leaves. It can be planted from the first of October till the fifteenth of May, according to locality and climate. The fruit is white, smooth, and very sweet.

The **Moretti** is the *Morus Elata*, and is used some along the Alps, South France, and North Italy. It is hardy, grows tall and straight, has luxuriant foliage, and is good for standard or ornamental trees. It produces one pound of cocoons to about fourteen pounds of leaves. Its leaves are very large, oval, sharp-pointed, entire, cordate at base, thin, and smooth on both under and upper surfaces, rather deep shining green in color.

Morus Rosea has a large rose-shaped leaf. It can be planted as standard, hedge, or ornamental tree. It is slender, and has more extended branches than any other variety. Its leaves are shining as if varnished, and its fruit is of a rose-gray. It is not so good as the Japonica; and produces one pound of cocoons to about fourteen pounds of leaves.

Morus Alba proper.—This is the parent stock from which the *Japonica*, *Moretti*, and *Rosea* are cultivated varieties. It yields one pound of cocoons to fourteen or sixteen pounds of leaves. It is used

generally in France, Italy, Spain, and all silk-growing countries as standard; and it is abandoned only as the growers become acquainted with the improved varieties. The leaves are cordate, serrate, entire, or lobed; the upper surface is a shining green, perfectly smooth, and the under surface has some hairs on its edges. The fruit is white, roundish-oblong, and insipid. The trees grow rapidly.

Morus Multicaulis (from the Philippine Islands) is delicate, and grows well and large in the South. Those who have it will do well to feed on it until they get better trees. It produces one pound of cocoons to about eighteen pounds of leaves. The leaves are very large, soft, and serrated near the summit. The fruit is white and bearded.

Morus Nigra (from Asia Minor) is used successfully in Northern or colder states and countries, and it will produce good silk. It is very hardy, will grow anywhere in the United States or Canada, and makes good timber. Its fruit is large, black, aromatic and juicy. The leaves are large and rugged.

Morus Tartarica, or Caucassian Mulberry, produces a strong silk, grows rapidly, attains large size, is a prolific fruit-bearer, available for orchard or forest, and makes good timber. The fruit resembles the *Morus Nigra*.

Osage Orange is a silk-food, produces fair silk, but less in quantity. Those who have this plant may use it advantageously, and with good profit,—

especially as learners and beginners. Prof. Riley, of the Agricultural Bureau at Washington, thinks well of it; but practical silk-culturists do not. We commend it as an intermediary.

To attain the *best* profits, the best White Mulberry (Japonica) must be used.

Dwarf Mulberry is attained by cutting close to the ground, and thus forcing numerous sprouts. It may be brought to great perfection, out of any variety, furnishing as many leaves as another tree twice its size, and a much greater number of plants will grow in any given space.

Paper Mulberry (from Asiatic Turkey) is sometimes classed as a silk-food. We do not class it as such. Worms will feed on it, but are likely to die from its effects. The leaf is large, rough on the upper surface, and white on under surface. The tree is barren of fruit. It can be grafted with Japonica, and thus makes good food the second year after grafting.

Lettuce.—Worms will sometimes eat lettuce, and the young leaves of the castor-oil plant. These may sustain life a few days, in emergencies of too early hatching, until the young mulberry-leaves come; but these are not silk-producing foods.

The old stock of mulberry-trees growing in the United States since 1838 must now be classed as wild trees. The varieties of these trees which produce smooth white fruit — without bearded seeds — are available for cuttings and grafting; and thus

utilized may produce good results. Any of these trees (except the paper mulberry) may, however, be used as food by beginners, and until standard food can be secured and grown.

Seeding.—One ounce of seed properly sown will produce about 5,000 trees.

Sowing of mulberry-seed should be done between the first of April and the first of July. Put the seed in blood-warm water, and let it soak twenty-four hours before sowing. Sow in drills two to three feet apart.

Drills must be carefully pulverized; and a small furrow, an inch deep, should be run in each drill, for receiving the seed. Ground should be prepared by plowing first in the fall and again in the spring: it should be stimulated, but not with heating manures.

Cultivation.—The seed-drills and very young plants must be protected from frosts by covering with leaves, straw, or matting. If the weather is dry, water every other day or once or twice a week with barnyard drain or soapsuds, always before the rising or after the setting of the sun.

If the plants come too thick, trim them when the size of a goosequill, and put them two or three inches apart. They must be weeded, watered, and tilled. The second year, prune off all small branches up to a foot from the ground; and cut off entirely all that are poor or grubby.

Transplanting.—When the seedlings are eighteen

inches high—generally the second year—transplant to nursery, hedge, or dwarf orchard. Do not injure the roots. Plantation standards are transplanted from the nursery when four to eight feet high.

Reproduction.—There is no absolute assurance of reproducing a particular kind or variety from seed. The seedling varies more or less,—is not precisely the same in kind as the parent. A particular or definite variety of mulberry can be perpetuated without any variation only by grafting or by cuttings. But this is true of fruit-bearing trees generally.

Cuttings.—Make cuttings nine to twelve inches long, with four to six eyes; bury two-thirds of each cutting, leaving two eyes out, twelve inches apart, in furrows three feet apart. Plant in spring in northern silk States, and in either spring or fall in Southern States. The large old trees of *Morus Alba* —that which yields a smooth *white fruit without beards upon it*—afford cuttings which, by careful cultivation or grafting, make excellent and standard food-trees. Water cuttings in dry weather, and keep clear of weeds.

Pruning.—June is the best season for pruning, when the young twigs which are taken off can be given to the worms.

Grafting.—The very finest tree and the highest perfection of food are in mulberry, as in other fruit-trees, attainable only by grafting or budding.

Nursery.—The ground should be well prepared, and well manured.

Run rows six or eight feet apart, and transplant seedlings one foot apart in the rows, and press the earth closely around.

When the plants spring, strip off the side buds, except such as are necessary to form the heads of trees. If they do not shoot well the first year, cut them over in the following March about seven inches from the ground.

Hedges.—The white mulberry forms an excellent hedge. Cattle must not be allowed free access to it while young; but after it has become a good fence, the more it is broken and lacerated by cattle the more impenetrable it will become, as every broken branch immediately sends out half a dozen shoots, till the bush forms a perfect bramble. This makes a perfect fence, supplies food for silkworms, and keeps the trees so low that the leaves may be gathered by children.

To Make the Hedge.—Take seedlings or cuttings two years old, and set them in the spring one foot to eighteen inches apart on the fence-line. Cut off the tops four to six inches from the ground. Leave two buds opposite each other, and remove all the rest. The next spring cut off one of these two branches in such a manner that each plant may have a long one and a short one. Height, form, &c., may afterward be regulated according to fancy by cutting the branches and feeding the silkworms with them.

ORCHARDS.

Dwarf Orchards.—Transplant seedlings when two years old six feet apart. An acre will thus contain 1210 trees.

Form the crown of the trees by trimming down about one foot from the ground.

In the third and succeeding years do not trim until after gathering the leaves.

For a few years vegetables may be cultivated between the trees with advantage to the orchard.

Standard Orchards.—For standard orchards set trees, from the nursery, twelve feet apart, in the fall. An acre will thus contain 302 trees. Along fences, which are kept well cleared, trees may be planted even six feet apart.

For immediate work one hundred to one thousand *Morus Japonica*, three to four years old, should be planted in the fall. Each hundred of such trees will feed a half ounce of eggs (20,000 worms) the next spring; and one ounce of eggs (40,000 worms) the succeeding spring. Increase the orchard by cuttings, seedlings, &c. Cultivate vegetables between the trees till the limbs nearly meet. Meantime manure well.

Hedge Orchards may be planted on good ground, well manured, and thoroughly cultivated, in the following manner.

Plant trees of one year's growth in rows six feet apart, each tree three feet from the next in the same row. Thus an acre, or 43,560 square feet, will con-

tain 2420 trees. In their third year each tree will yield about two pounds of leaves (or 4840 pounds per acre), and this quantity will be doubled annually till the eighth year.

Third year's yield,—		4,840	pounds	leaves.	
Fourth	"	"	9,680	"	"
Fifth	"	"	19,360	"	"
Sixth	"	"	38,720	"	"
Seventh	"	"	77,440	"	"
Eighth	"	"	154,880	"	"

Thus an acre of ground in *Morus Japonica* would yield 1548 pounds of reeled silk, which at the low average valuation of $5 per pound is worth $7,740.

Streets and Parks.—Cities and towns may adorn their streets and parks with mulberry as shade and ornamental trees; and these trees may be the means of turning many a hovel into a cocoonery, and making the poor, aged, and infirm self-supporting and contented.

Churchyards and Schoolhouses.—As the mulberry makes beautiful shade-trees, its cultivation around country churchyards and schoolhouses will afford opportunity for pastors and teachers to improve the material as well as the spiritual and intellectual condition of their parishioners and pupils.

Public Highways.—In parts of France the roadsides are planted with mulberry-trees, and rented annually at auction. The income is sufficient to keep the public highways in repair, and is thus advantageously appropriated.

The Hardiest Trees are the *Nigra* and *Tartarica*. These are used in Nebraska. The hardiest trees in the mountain districts of Italy are obtained by grafting *Japonica*, *Moretti*, *Rosea*, or *Alba*, upon *Nigra* and *Tartarica*. This combination produces good food and hardy trees,—the best for colder latitudes.

LEAVES.

Yield.—Clark gives the following table of yield of leaves from seedlings:—

Four years from the seed,—	4	lbs.	of	leaves.				
Six	"	"	"	"	7	"	"	"
Eight	"	"	"	"	12	"	"	"
Ten	"	"	"	"	20	"	"	"
Twenty	"	"	"	"	150	"	"	"

Thus seedlings planted in dwarf orchard (1210 to acre) in *Morus Japonica* will yield 4,840 pounds of leaves the fourth year, being equal to 484 pounds of cocoons.

Gathering Leaves.—Put on a bag-apron. Pass the hands from the lower part of a branch to the top, and strip the leaves upward, not downward, as the latter would injure the buds. This should be particularly observed. In short, the process requires care to prevent the trees, especially young ones, from being injured. In cutting off shoots or branches use pruning-shears.

If you have hedges and orchards or plantations, begin by pulling the leaves of the hedges; then proceed to the young trees of the orchard. Such branches as are stripped should be stripped com-

pletely; for if any leaves remain on a branch they attract the sap, and the naked branch is unequally nourished.

But strip only one third of the leaves from a tree at one time when young, and one half when old.

Forcing Leaves.—It would be well to have a strip of garden hedge in a southern exposure quite near the house; and cover it at night with matting or carpet. This would force the leaves early; and if your worms should hatch out before the trees are in leaf, this hedge would keep them alive, as at first they consume but little.

Wet Leaves.—Never feed wet or damp leaves. They should be gathered after the dew has gone in the morning and before the sun sets at night.

Dusty leaves should be wiped with a cloth before feeding.

Renting Trees and Selling Leaves.—In villages and towns this can be easily done. Many people who have uncultivated land would no doubt be glad to plant trees for the purpose of selling the leaves, if they knew there would be a demand for them. In large cities, where one must go miles to find uncultivated land, the cost of going or sending for leaves to the raiser of worms would not make this procedure practicable.

If one has only a city lot, he can plant trees on the sidewalk, and perhaps get room for one or two dwarf trees in the yard, which would furnish food for amusement as well as experiment.

II.

THE COCOONERY, HOW TO CONSTRUCT AND MANAGE.

The Building.—An unused outbuilding or shed may be turned into a cocoonery, by proper alterations.

Buildings erected for the purpose should rest upon posts or brick pillars twelve to twenty-four inches above ground, or upon cellars. Circles of tar should be put around the posts and pillars to intercept the approach of insects. Cellars are better than pillars, as they make storehouses for the leaves which have to be kept over night for early morning feeding.

Size of Building.—The building or room for feeding 40,000 worms should be about ten feet wide, fifteen feet long, and nine feet between floor and joists. For feeding 100,000 worms it should be about sixteen feet wide, twenty feet long, and ten feet between floor and joists.

Doors and windows must be protected by mosquito or wire nettings against winged insects, spiders, etc.

Plan of Room.—There should be two or more windows, on opposite sides; a ventilator in the floor, and one in the roof, which could be closed at will. The ventilator in the floor should be a square hole eighteen by twenty-four inches,—the pieces nailed together so as to close the hole tightly when desired.

Meantime the hole should be covered with fine wire-cloth to keep out rats and mice, insects, etc. Three feet floor-space should be allowed between the two sets of racks, and in this space the floor ventilator should be located. Therefore, the room should be longer than wide.

The room must be void of furniture, and the floor bare. The windows should let down at the top, and have shades to exclude the direct sun-rays. The worms do not mind the light, but they sicken in the sun. The room at all times must be well ventilated, but drafts of air must never come directly on the worms.

Space Required for Racks.—An ounce of eggs requires thirty-two trays and two double or four single racks. Double racks are six feet high, three feet wide, and four feet long: single racks are $6 \times 1\frac{1}{2} \times 4$ feet. Two double racks should be set end to end together, and occupy twenty-four square feet, —floor-space three by eight feet net. Three feet more floor-space should be allowed about the racks, to enable a person to walk around and distribute food evenly. Single racks may set close to the walls.

Shelves may be used instead of racks, though racks are better for regular work.

The shelves should be eighteen inches deep, eighteen inches apart, in rows six feet high, set near the walls, running from end to end of the room. These will economize space; but they involve more danger

to the worms, from insects and changes of temperature, by being near the walls.

Temperature and Moisture.—A small stove or fireplace should be in the room in readiness for cold days, for the worms must be kept warm. Temperatures which make you uncomfortable in very thin clothes will make your worms uncomfortable also.

When your hygrometer indicates a very damp state of the atmosphere, straw or wood shavings should be burnt to absorb the humidity, and replace it by the external air, which is dried by the same blaze. I have said blaze, and not fire, for two reasons. With two pounds of shavings or dry straw there can be attracted from all points toward the chimney a large body of air, which issues out at the flue of the chimney; while in the mean time the air is replaced by a similar quantity of exterior air, which spreads over the room and revives the silkworms. This change of air may take place without effecting any material variation in the degree of heat in the room. If, on the contrary, thick wood were employed, it would require more time to remove the interior air, ten times more fuel might be consumed, and the room would be too much heated.

When wood shavings or dry straw can not be had, small sticks of light wood may answer.

If you use a stove, the door of the same should be left open as soon as the fire is burning briskly.

At no time after hatching should the temperature

in the cocoonery fall below seventy-five or rise above eighty-five degrees.

If the temperature rise higher than eighty-five degrees, reduce it by sponging or mopping the floor frequently.

If you have no hygrometer a plate of salt will do as a tolerable substitute, as the salt will grow damp when the room is damp.

A pound of copperas dissolved in a pail of water will purify bad air or smell in the cocoonery.

Electric Conditions.—During thunder-storms and sultry weather unusual care must be given to ventilation. Under no circumstances must all the windows be closed. For this reason it would be better to have wooden-slat shutters outside of the windows, which will shed the rain and not exclude the air.

During sultry weather it will be cooler by keeping the shutters closed. In cool weather the shutters should be opened.

Ants.—As a precaution against them, the feet of the racks may be set in water. The mulberry-leaves should be examined to prevent ants being brought in on them.

Rooms in Dwellings.—If it is not possible to build a cocoonery, then a room in the house should be cleared out, and turned into one. An attic-room will answer in many cases; but it must be perfectly clean and thoroughly ventilated.

Cocoonery Rules.—At the beginning of each season, or crop,—

1. Scrub the floors very carefully.

2. Whitewash the walls.

3. Cleanse trays and frames which have been used by singeing them as you would singe a fowl, or wash them in a solution of sulphate of copper; and put new coverings upon the trays.

4. Throw chloride of lime on the floor, and plentifully in the corners. Then tightly close the windows and doors for twenty-four hours. Afterward wash the floor again, and air the cocoonery.

While rearing,—

5. To avoid smoke, do not heat the cocoonery with coal or undried wood, or let a fire be badly or insufficiently kindled.

6. Before feeding, expose the food to the temperature of the cocoonery for at least an hour, so that it may not chill the worms.

7. Never sweep the cocoonery floor, but sponge it to avoid dust.

8. Renew the frame-covers whenever they become much soiled by excrement.

9. Clean and air the trays every morning.

Covering the Frames.—Drive four small half-inch brads along each end of the frames and six brads along each side, and cover the frames with tarlatan tightly drawn, for the first age or young worms. Use tarlatan through the first age.

At the close of the first age replace tarlatan with mosquito-netting, and use netting through the second age.

At the close of the second age replace mosquito-netting with perforated cardboard, or strong, tough paper.

The paper perforations should be round holes about six-sixteenths of an inch in diameter and about one eighth of an inch apart,—each sheet or frame-cover having thus about 1500 perforations.

III.

EGGS, HOW TO KEEP AND HATCH THEM.

After you have planted good silk-food, the next thing to do is to procure eggs. These are of a brownish gray or slaty gray or greenish color, and about as large as a grain of mustard-seed. The eggs should be received between November and May.

To Keep Eggs.—In order to preserve them till hatching time, place them in a wire-gauze box, tightly closed, and hang them in a cool and well-ventilated attic with a northern exposure, or a dry ventilated cellar. If the wire-gauze boxes can not be had, put them in a cloth bag; but suspend them by wire, for rats and mice are very fond of such food, and will take extra pains to get at it. It is said that eggs put in a goosequill, and the open end dipped in sealing-wax, will remain without hatching for years.

Examine your eggs occasionally to see if insects have attacked them, or if they have been affected by mold. If the latter occurs, it shows that the place they are in is too damp, and they should be removed to a dryer atmosphere at once. The temperature should be kept not above forty degrees. If the temperature should rise higher than this before the leaves are on the trees, the tin box containing the eggs must be placed in a wooden box, and this put in an icehouse or refrigerator. Your butcher

will no doubt keep them for you in his ice-box for a small charge. They should be hung up the same as his meat.

Hatching.—As soon as the leaves are opening on the mulberry-trees, the eggs should be brought from a temperature of forty degrees to fifty degrees for an hour or more; then to sixty degrees for another hour; then to the hatching-room at seventy degrees,—and here spread them out very thinly in the trays. The temperature should be increased to seventy-five degrees during the last days of the hatch, and should be maintained until the hatching terminates.

All this time there should be some ventilation, but not drafts; and the eggs should never be put in the sun's rays. A pot of water on the fire, shallow pans of water set about the room, or the sprinkling of the floor, will facilitate the hatching. In France a room with northeastern exposure is considered the best for a cocoonery.

As the temperature rises the color of the eggs passes successively through bluish violet, ashy, and yellowish shades; and lastly they become more and more whitish every day as the hatching-time approaches.

If looked at closely, one sees a black spot and a brownish crescent extending along the circumference. The black spot is the head of the worm, which closely touches the shell: the crescent is the body, which is already covered with little hairs.

When it leaves the egg, the silkworm gnaws through the shell on its side, never on its flat surface. When the opening is large enough, it breaks out through it, head foremost, and immediately fixes a thread of silk to any object it can reach, no doubt in order to keep itself from falling. Sometimes the opening is too small to allow of the head passing out, and the larva is forced to come out tail foremost. At times, not being able to get its head free, the worm very soon dies of fatigue and hunger.

On the first day but very few worms are hatched; but on the second and third days the hatching is very abundant.

Of these newly born worms three divisions are made.

Hatches.—Worms born on the first day are removed to another place or tray, and are called the *first hatch.*

Those born the second day are removed and called the *second hatch.*

Those of third day are called *third hatch.*

Those of fourth day, if strong and lively, are called *fourth hatch.* If they seem weak they had better be thrown away.

These directions must be followed to insure evenness in molting.

All eggs not hatched after the fourth day had better be thrown away.

Premature Hatching may be accomplished by freezing eggs and then bringing them very gradually

to higher temperatures. But it involves risk of degenerating the race. For grades of temperature see "Hatching," page 27.

Feeding.—As soon as the worms are hatched, place over them a frame covered with tarlatan, and over this frame place the mulberry-leaves, on which all the little worms congregate by crawling up through the tarlatan. Then place the tray on a table or in a rack.

The worms that after a while do not climb up through the tarlatan are weakly and sickly, and had better be destroyed.

They are given as a first meal tender leaves cut into little pieces with a chopping-knife, similar to coarse smoking-tobacco.

The knife must be perfectly clean; and tobacco, or even tobacco-smoke, must not come near the worms. All strong odors must be kept from them; and one must be careful not to let any other kind of leaves get in with the mulberry-leaves.

It is a fact well known and guarded against by French and Italian culturists, that the leaves of apple, peach, plum, and many other fruit-trees, will kill the worms.

Changes of Food.—When necessity has caused you to change the food from mulberry to osage orange, or *vice versa*, do not change a second time. These changes are apt to hurt the worms, and stunt their growth all through life.

Quantity of Food.—An ounce of eggs should produce 40,000 worms. Below is a table giving the amount necessary to feed them until they spin.

First	age,	6 days,	about	5 lbs.	daily.
Second	"	5 days,	"	10 "	"
Third	"	5 days,	"	25 "	"
Fourth	"	5 days,	"	60 "	"
Fifth	"	8 days,	"	150 "	"

Average quantity first age,	30	lbs.
Average quantity second age,	50	"
Average quantity third age,	125	"
Average quantity fourth age,	300	"
Average quantity fifth age,	1200	"
Total, ...	1725	

About two-fifths of which is waste.

IV.

HOW TO REAR SILKWORMS.

The Ages.—The worm goes through molts, or sicknesses. The periods between these different molts are called "ages,"—there being five of these ages, including the first after the hatching and the last before the spinning.

The first period usually occupies from five to six days; the second but four or five; the third about five; the fourth from five to six; and the fifth about eight days. The time from the hatching to the spinning usually occupies about thirty days.

Molting.—The worm grows so fast that its skin does not stretch in proportion to its growth, and it bursts its skin. Hence the more it is fed the more quickly it will molt.

Five or six days after the hatching they will commence to molt. One may know this by their becoming torpid, and appearing like small bits of rusty iron wire. At first a dark spot can be seen, by the magnifying-glass, in front of the first joint. This indicates the growth of a new head.

When its term of sickness is over, the worm casts its old skin. It then rests twenty-four hours to get new strength. As soon as the worm begins to move about, give it a light meal of wild mulberry, if you have it. Afterwards give the regular food.

In the operation of molting the new head is first

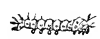
disengaged from the old skin, which is then gradually worked back until entirely cast off.

If the worm is feeble the shriveled skin may remain on the end of the body, being held by the anal horn,—in which case the worm usually perishes.

First Age.—During the first age they are given six meals a day of finely chopped leaves, taking care to distribute their food to them as equally as possible. The first meal is given early in the morning: the last at eleven o'clock at night.

The frames should be covered with coarse tarlatan during the first age.

FIRST AGE.



Before molting.

After molting.

Second Age.—During the second age still cut the leaves for the worms, but into larger pieces, and proportioned to their size. During the day the room should be kept a little warmer than at night. At the end of this age they have only four meals a day.

The frames should be covered with mosquito-netting at the commencement of the second age.

SECOND AGE.

Before molting.

After molting.

Third Age.—During the third age the number of meals is kept to four, the first being given at four

to five o'clock in the morning, and the last about eleven at night. The leaf is cut into large pieces or left whole, and distributed as equally as possible. The net or paper is spread over the worms and leaves; and when the worms have congregated on the same, it is removed to clean paper or to the tray, and the *debris* is burned.

One will be apt to find at this period worms that have not strength enough to molt. They are larger than those that have just awakened, and that have not as yet eaten and are shiny. These must be carefully removed, for they will soon die.

The frames are covered with perforated paper at the beginning of this age, and used till the worm spins.

THIRD AGE.

Before molting.

After molting.

Fourth Age.—During the fourth age do not cut the leaves, but give them a great many more leaves at once. The result is, the litter increases in thickness, and the cleaning of the trays must not be neglected. The molt that follows the fourth age is the most critical phase in the life of the silkworm. During their sleep they are a prey to the most acute suffering, and are plunged into a state of lethargy which resembles death. This molt lasts longer than the other molts.

During this time the room should be kept very well ventilated and the trays very clean.

It is when they awake out of this last sleep that disease may break out. The yellow or fat ones and the soft or indolent ones die easily.

Several persons have written me that they have saved their sick worms by putting them out of doors. One lady unknowingly threw away some silkworms, and they remained out in a heavy two-days' storm. At the end of that time she found them alive and well, and they afterward spun fine cocoons.

As ants, mice, and birds are always to be guarded against, I would suggest a hanging shelf in an open shed for all sick worms, with perhaps some netting stretched about to keep away winged insects.

FOURTH AGE.

Before molting.

After molting.

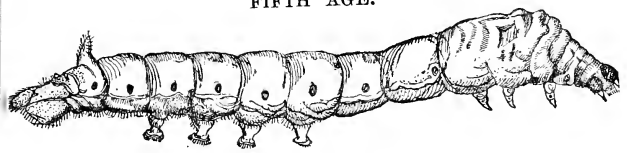
The worms at the end of the fourth molt are lean and feeble. They must now have an abundance of leaves every day till the beginning of the fifth age.

Fifth Age.— During the fifth age the worms become large so quickly that on the fifth or sixth day they are obliged to be moved away from each other on the litter. The trays should be carefully cleaned every morning on account of the enormous amount of excrement; and at the same time good ventilation must be constantly retained.

Having attained full growth the worm is ready to go up to spin. It ceases to eat, turns yellow or pearly white, and becomes transparent as a grape.

Up to this time the worm has never thought of wandering away from its food. Now it is seized with an irresistible desire to leave its quarters. It

FIFTH AGE.



Ready to go up and spin.

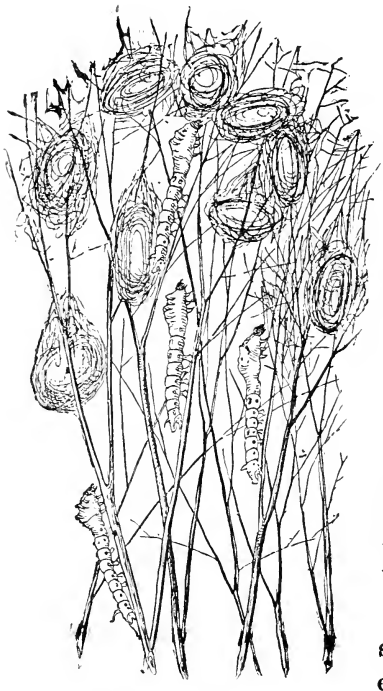
gets up, roams about, and moves its head in all directions to find some place to cling on to. It now looks for a convenient place to spin its cocoon.

How to Handle Silkworms.— Handle the large worms with flat, inch-wide camel's-hair brushes, or leaves.

Never take them up with your fingers.

When the small worms will not leave the old dry food, press over them lightly a soft plush brush or very soft hat-brush. The worms will adhere to the brush. The brush should then be lifted and shook closely and gently over the fresh food, when some of them will fall; others will hang by a silken thread which they always throw out when they feel there is danger. The brush should then be passed lightly over the leaves. This will detach them, and cause them to stick to their new food.

Spinning Branches.— Bunches of dry twigs without leaves, or bunches of wheat-straw or broom-corn, tied near the bottom, should be spread out thinly in the form of fans, so that the air can circulate freely, and be stood in the racks about the edges of the trays.



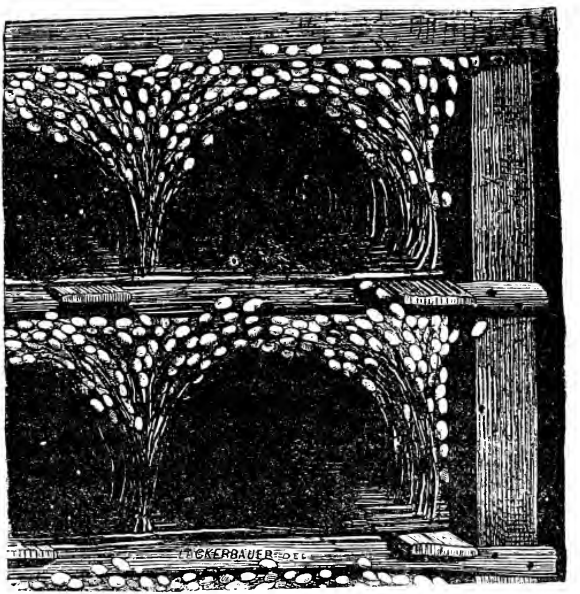
SPINNING BRANCHES.

There will be lazy worms that will not mount. These should be removed to another place, and dry branches placed in their way. They will soon mount the branches and begin their work.

The temperature should be kept even, and plenty of ventilation be given, but they should all be kept as dry as possible. All excrement and diseased or dead worms should be carefully removed.

Those that drop down while spinning must be carried out and placed with the lazy ones.

Spinning the Cocoons.—When the silkworm has mounted the branch to spin, it begins by attaching, to numerous twigs, threads to support the cocoon. These threads are afterward called waste silk.



SPINNING BRANCHES ARRANGED IN THE RACKS.

After the proper space has been circumscribed by this means, the worm begins to disgorge or spin its thread, which is continuous, and from six hundred to eight hundred yards in length.

It has been calculated that sixty thousand cocoons would suffice to surround the earth at the equator with a thread of silk.

Folded on itself almost like a horseshoe,—its back within, its legs without,—the worm arranges its thread all around its body, describing ovals with its head. Its head is said to complete sixty-five elliptical motions a minute—or a total of three hundred thousand—in making a cocoon, discharging the thread at the rate of four to six inches a minute.

About the fourth day, after having expended all its silk-fluid, the worm, shut up in its cocoon, becomes a waxy white color, and swollen in the middle of the body. The abdominal legs wither away; the six fore-legs approach each other and become black; the parts of the mouth tend downward; the skin wrinkles. Very soon it is detached and pushed down toward the hinder part, and the chrysalis appears under the rents in the skin. It is first white, but speedily becomes of a brown red, and remains in a pupa state from fifteen to seventeen days.

In three days from the commencement of spinning the silkworms finish their cocoons, and in five to eight days they are ready for picking.

The cocoons should be large, heavy, and well shaped. The good ones are regular, their ends are rounded, and they are hard and have a fine grain. The best are drawn in toward the middle, or have a concavity on either side, that is, peanut-shaped.

V.

RACES, VARIETIES AND VALUES.

Migratory Effects.—Migration and varied domestication have had the effect of producing numerous varieties of the silkworm, every different climate into which it has been carried having produced either some changes in the quality of the silk, or the shape or color of the cocoons, or altered the habits of the worm.

Individuals of the same race exported to a dozen different localities would, in all probability, soon present a dozen varieties.

Annuals and Polyvoltins.—Some races produce but one brood in a year. Such are known as *Annuals.* Annuals are the strongest and hardiest, and are preferred in France, Italy, and Europe generally, where they now use, with great success, what are known as the Pyrenean, Cevennes, Var, Milanese, and Roumeliam (Adrianople) varieties.

Experiments, taking into consideration the size of the cocoon, quality of silk, time occupied, hardiness, quantity of leaves required, etc., have proved the Annuals to be more profitable than any of the Polyvoltins, although Bivoltins are often reared.

Those known as *Bivoltins* hatch twice in the course of the year: the first time, as with the Annuals, in April or May; and the second, eight or ten days after the eggs are laid by the first brood. The

eggs of the second brood only are kept for the next year's crop, as those of the first brood always either hatch or decay soon after being laid.

The *Trivoltins* produce three generations annually.

Quadrivoltins produce four generations a year. Some Quadrivoltins molt but three times instead of four, especially in warm countries.

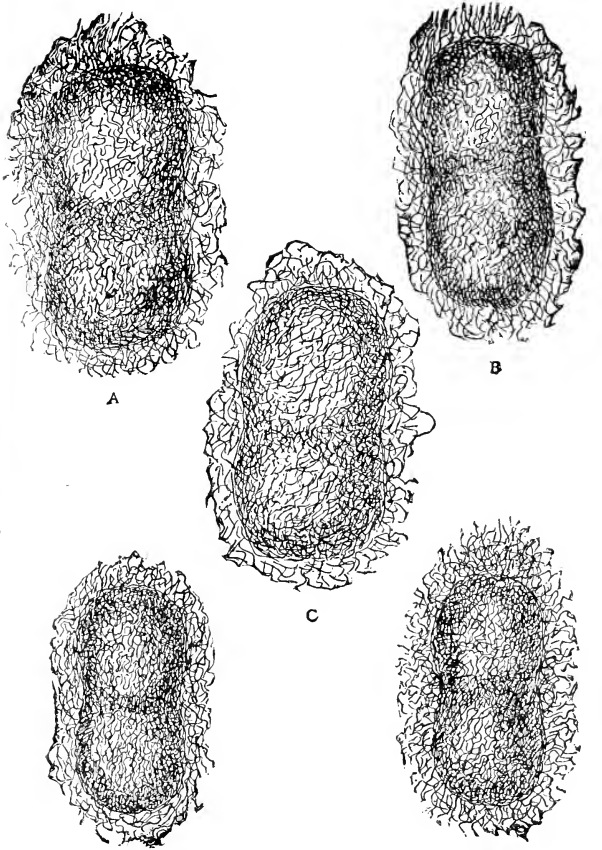
Color and Size.—Varieties are also known by the color of the cocoons they produce, as Greens, or Whites, or Yellows; and also by the country in which they flourish.

The white silk is the most valuable in commerce; but the races producing yellow, cream-colored, or sulphur-colored cocoons, are generally considered to be the most vigorous.

The three most marked and noted European varieties are the Italian breed, producing small yellow cocoons; the French, producing large yellow cocoons; and the Turkish, producing large white cocoons.

There are two principal Japanese Annuals,—one producing white and the other greenish cocoons, and known respectively as the white Japanese and the green Japanese Annuals. These cocoons are by no means large, but the pods are solid and firm. Both varieties are about of a size, and are almost always constricted in the middle.

The white Chinese Annual resembles the white Japanese, but is not as generally constricted.



A. French and Turkish, yellow. B, Italian, white.

C, Turkish and French, white.

D, Japanese, green and white. E, Chinese, white and yellow.

Weight.—The large cocoons of the French and Turkish varieties are estimated to average 300 to a pound (stifled and dried), and to yield 133 pounds from an ounce of eggs.

The small cocoons of the Italian, Japanese, and Chinese varieties are estimated at 450 to a pound, and to yield 89 pounds from an ounce of eggs.

Relative Values.—Estimating $10 to be the highest standard price, or the maximum mercantile grade, for a pound of reeled silk produced from any race, the *relative* values of the regular distinctive varieties are about as follows:—

Best Turkish (pure white), . . .	$10.00
Best French, ...	7.00
Best Italian, ...	6.75
Best Japanese, ...	5.75
Best Chinese, ...	5.00

Grades and values are determined by color, sinew of thread, and skill in reeling.

The white Turkish can not be classed as a *regular* variety, because it is very difficult, in rearing, to prevent pure white cocoons from being soiled. Hence their cultivation is not general, is confined exclusively to experts, and the product is comparatively limited.

VI.

GATHERING, STIFLING, AND PACKING COCOONS.

Gathering.—The gathering should be commenced about five days after the worms have begun spinning.

The finest, largest cocoons, should be selected for eggs; and these must remain in the branches eight or ten days.

The others should be carefully taken from the branches, with all their floss.

The loose, ragged floss, should then be taken from the cocoons with great delicacy, to prevent the cocoons from being flattened or bruised. The envelope-floss—a little loose case that envelopes the cocoon—must remain on to keep the cocoons clean.

Sorting the Cocoons.—This should be done at the time and by the person who takes off the floss. The imperfect and soiled ones should be put together, and the perfect, clean ones, should be kept apart from them, as the clean ones will bring higher prices. The black, soft, wet ones, should be discarded.

Double Cocoons can not be reeled, but can be sold with the pierced cocoons. Some use them for reproduction. Others advise against it.

Stifling.—When the cocoons have been sorted, unless it is desired to reel them immediately or to

sell them green, they must be stifled to prevent the chrysalides from emerging. This is done in various ways. The processes commonly used comprise—

Steaming,
Dry hot air,
Charcoal fumes,
Solar rays.

Hot Air.—To stifle by dry hot air, the cocoons should be placed in shallow perforated pans, and these put in an oven with a temperature of two hundred and twelve degrees, and allowed to remain thirty minutes.

Care must be taken to prevent the temperature from rising above this; for if the cocoons are the least scorched, it hurts their value very much.

After they come from the oven they should be spread out in a dry sunny room for several days.

Steaming.—The cocoons should be put into a coarse bag or steam stifler, and steamed for a half hour over boiling water, the same as potatoes are steamed. At the end of that time they should be spread about two inches deep, on sheets in the sun, and stirred four times a day until thoroughly dry. It sometimes takes ten days to dry them.

Charcoal Fumes.—The cocoons must be placed in a small, tightly closed room, detached from the rest of the house, or hung in a basket or bag in the top of a large box or hogshead with the bottom out. A pot of burning charcoal must then be prepared, and the box or hogshead must be set over it, the

earth banked up solidly around it, and allowed to remain twenty-four hours. If a box or hogshead is used, all seams or cracks must be tightly closed with lead or putty.

The Italians sometimes put sweet-scented herbs in with the burning charcoal, which gives the cocoons a pleasant perfume. The cocoons, on being taken out, should be spread in the sun for six to eight days to dry, and should be stirred frequently.

Solar Rays.—In the tropic South the cocoons can be stifled by spreading them out in the sun for three or four days. But it is much better to have large tightly closed glass-covered boxes in which to place the cocoons. This will insure a greater heat, and will stifle them more quickly; and besides will keep away insects. The boxes should be opened three to four times a day long enough to stir up the cocoons.

Precautions Against Cocoon Enemies.—Mice and rats will gnaw holes in the cocoons to get to the chrysalides. A mite attacks them while drying, and a moth cuts the silk. To keep them away, sprinkle gum-camphor among the cocoons.

Packing-Cases.—They should be made of light pine, with horizontal partitions about a foot apart, to keep the cocoons from being mashed. The partitions can be made of thin slats, each slat about one fourth of an inch above the other, so as to prevent much weight.

Weighing for Market.—The box or case should be weighed before packing. After the cocoons are packed it should be weighed again, and a careful memorandum made of both. You get paid for the weight of the cocoons only.

How to Pack.—Pack the perfect cocoons, and the imperfect and soiled cocoons, rather loosely, in separate divisions or boxes, each kind to themselves. Compact them by shaking the box, not by direct pressure.

The pierced and mashed ones can be packed as tightly as they will pack, for these will be carded and not reeled.

When to Ship.—Green or unstifled cocoons should be shipped as soon as taken from the spinning branches.

Stifled or dried cocoons, after ten or more days' exposure to the sun's rays.

Pierced cocoons at any time.

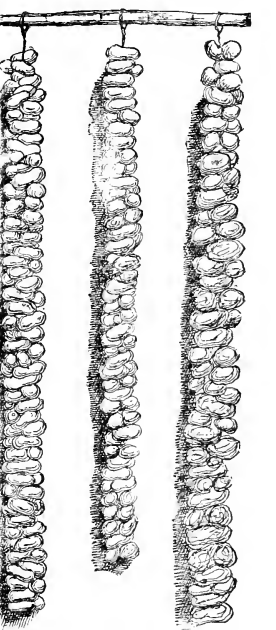
Floss or waste at any time.

How to Ship.—Four pounds or less can be sent by mail at one cent per ounce. Larger quantities had better be put in wooden boxes and sent by freight, especially for long distances. Shipments at short distances, say two to four hundred miles, may be sent by express. But express charges on large boxes for long distances curtail the profits of small culturists and beginners very seriously.

VII.

REPRODUCTION.

Stringing Cocoons.—When the cocoons selected for reproduction have remained on the branches eight days, they are taken down, stripped of their loose floss, and strung on a thread. This is done by sticking the needle lightly through the side of the cocoon. The greatest care must be taken not to pierce or disturb the chrysalis inside.

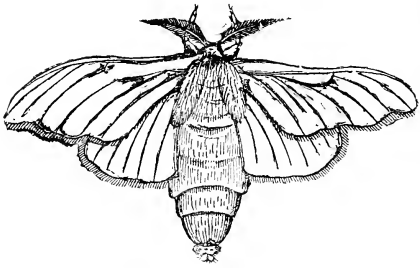


STRINGS OF COCOONS.

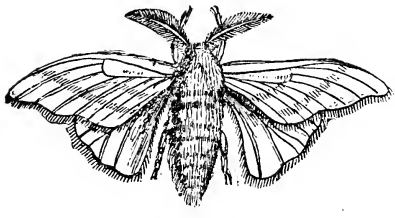
When the strings are a yard long hang them up against the wall in a dry, moderately dark, and well ventilated room.

Sexes.—Some say that the male cocoon is smaller than the female, depressed in the middle, and somewhat sharp at one or both ends; that the female cocoon is larger, more round and blunt at the end, and but slightly (if any) depressed. Others again assert that the sexes can only be told by weighing,—the female weighing the most.

Mating, or Coupling.—From twelve to fifteen days after the worms spin the cocoons the moths will begin to appear. They come out from four to eight o'clock in the morning. The sexes are easily distinguishable. The female is quiet, sluggish, and has a large body, full of eggs. The male is smaller, its wings are tinged with gray, and it flutters them constantly. The very moment the male moth comes out he goes in quest of the female, and they will in most cases mate immediately.



FEMALE MOTH.

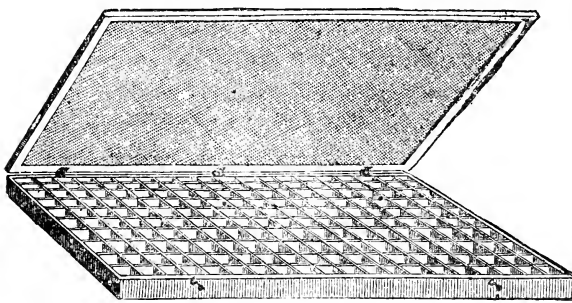


MALE MOTH.

As soon as mated lift them by their wings and put each pair on a clean sheet of paper or cloth, or in a cell of the mating-box, in a darkened room, with a temperature of about seventy degrees. They should remain mated or coupled six hours. If any should become uncoupled too soon they must be put together again or given a new mate or removed,

as the male will make such a noise with his wings that it will disturb the rest and cause others to become uncoupled.

As the domesticated silkmoth can not fly, some may be so far apart that they can not couple. In such case bring them together.

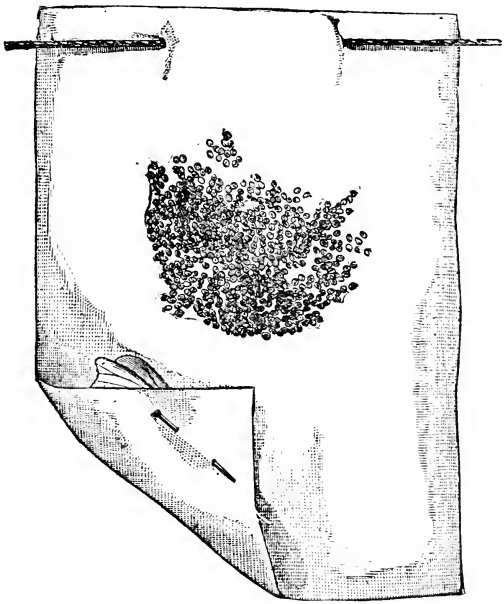


MATING BOX.

If you have more males than females keep the extra males in a perforated box—for the next day you may have more females than males. If it should happen that your females outnumber your males the first day, use the liveliest males over again, as soon as they uncouple, for the unmated females.

The uncoupling should be done with care. Catch the male and female by the wings with the thumbs and forefingers, and press the abdomen of the male with the middle finger, and they will uncouple easily.

Cells for Laying Moths.—These cells are sections of thin unbleached cotton, three by four inches. Pass a string through the top and hang them across the cocoonery. As soon as the female



A CELL, EGGS, AND MOTH PINNED IN CORNER.

moths have been separated from the males, place each on one of the squares and darken the room. Very soon the female will eject an egg covered with a viscous liquid which causes it to adhere to the cloth upon which it falls. Then she lays a second

egg by the side of the first, then a third by the side of the second, and so on. She rarely piles them upon each other.

The laying lasts for about three days, and each female averages 350 eggs. As it takes 40,000 eggs to make an ounce, 120 cells will give a very fair ounce. When the number of eggs laid by each moth is uniformly large or bountiful, 100 cells make an ounce. Or the cell may be weighed before the moths lay, and then weighed again after the moths have laid. An ounce can in this way be weighed accurately.

The moths live from eight to twelve days, and eat nothing. As soon as their mission is ended, throw them away or feed them to the chickens.

After the moths have remained on the cell six or seven days, take them down. It is well to pin a moth in the corner of its cell now and then, so that they can be examined by the Pasteur system for disease.

Eggs.—When they are first laid they are of a bright yellow color. Those unimpregnated remain yellow; those imperfectly so, reddish; and neither will produce worms. The good eggs in a fortnight will turn brown; then they change to a reddish gray; then they become a slaty gray, and remain so till nearly hatching-time.

Some bivoltin and trivoltins' eggs never turn very dark, as they hatch out in about fifteen days after being laid.

The Pasteur System is an examination of the moth by microscopic process. In France and Italy the worms are frequently diseased. In this country no disease has yet appeared. But as a precaution against disease, it is well to pin a moth now and then on its cell, so they can be examined. The moth is kept for two or three months, then rubbed to powder, and the powder examined for the dangerous fungi. Eggs laid by diseased moths must be thrown away.

For instructions in regard to keeping eggs see chapter on "Silkworm Eggs, How to Keep and Hatch Them," on page 26.

VIII.

REELING AND SPINNING.

Raw Silk and Reeled Silk.—The distinction between raw silk and reeled silk is perfectly well defined, and the difference in fact is absolute. It is an erroneous and thoughtless use of language to confound the two commodities under one name.

One bears the same relation to the other as raw cotton does to spun cotton or cotton yarn.

When cotton is first gathered from the stalk it is called *seed cotton*, as it still has the seed in it. When it has been ginned,—that is, when the seed are extracted,—it is *raw cotton*. When it has been carded and spun, it is *cotton yarn* or spun cotton.

When cocoons are first gathered from the branches they are green cocoons, or *seed silk*. When they are stifled or pierced they are *raw silk*,—which includes, specifically, dried and pierced cocoons, waste, and floss. When the dried cocoons are reeled, and four to ten strands or filaments have been spun or twisted into one thread or yarn, it is *reeled silk* or *grége;* so also is the waste and floss when carded and spun.

What Reeled Silk Is.—Ben. F. Peixotto, U. S. Consul at Lyons, France, in his official report to the Department of State, at Washington, October 22, 1881, says:—

"Raw [reeled] silk, that is to say, silk as reeled from the cocoon and imported for the use of our

silk-mills, *is really a manufactured article;* and moreover an article the value of which depends very largely upon the excellence of the *manufacturing processes* through which it has gone.

"The filature (reeling) of silk comprises three operations, each requiring considerable skill and great care to produce good silk. In the final operation of reeling, the *grége*, or reeled silk, is made.

"Fine as it is, a single thread of silk is formed of from four to ten or more separate filaments, each derived from a separate cocoon.

"To reel the silk the cocoons are put into hot water, and the filaments from several of them being united by being pressed together adhere to one another because of a natural gum with which they are covered and which is softened by the hot water. The thread resulting from the union of these filaments is then wound on a reel, the cocoons each paying out its filament until exhausted.

"The reeler's business is to form this thread of silk and *to keep it as regular as possible* in size by adding new cocoons to the running thread as required. It is extremely difficult to reel with regularity,—only the best reelers, working with the greatest care and under the most favorable conditions, succeeding in making an extremely even thread.

"Now the degree of regularity has a great influence upon the price of silk. For example, China silks, which are produced from exceedingly good cocoons,

are not regular in size, which fact alone affects their price to a very considerable extent per pound, according to the market.

"Up to the present time it has been extremely difficult to test the regularity of silk. So difficult is it that silk has been and is yet bought and sold very much according to the reputation of the establishment at which it has been reeled, it being impossible to judge exactly of the regularity of any silk until made up into goods, at which time any defects show and mar the beauty and value of the fabric."

Hence reeled silk is not raw silk, though it is commonly called "raw." It is as much a manufactured article as cotton yarn. Indeed it passes through more processes, and requires more highly skilled labor and more delicate machinery for its production.

Technical Grades of Reeled Silk. — Reeled silk is classified into organzine, tram, and floss. Organzine is closely spun or twisted, and is the best. Tram is made from inferior cocoons, and is more loosely spun or twisted. Floss is made of the loose silk carded and spun like cotton or wool.

Nearly every silk-crop, as raised by individual growers, contains three or four grades of cocoons, and to produce good and uniform silk these must be separated, and each sort reeled by itself, producing several grades of silk. This is difficult for those who attempt to reel their own cocoons; and for this reason, and because of the advent of im-

proved machines, hand-reels, and single basins, have been nearly abandoned in France and Italy,—the women finding it preferable and more profitable to sell their cocoons.

"Therefore," says Consul Peixotto, "it is clear that the object of the silk-culturist should be to raise and market as good a crop of cocoons as possible, to the best advantage and at the least possible expense and risk."

The Process of Reeling. — The persons employed in reeling silk are mostly women, one standing or sitting before each basin, of which she has entire charge. The basin is made of copper, and, in the large establishments, the water in each basin is heated by steam, at the control of the operator. The cocoons are plunged into the water when it is near the boiling point, and moved about so that the gum which fastens the threads becomes uniformly and thoroughly softened. They are then beaten with a small birchen broom, having the tips split, so that the loose threads readily fasten to them. After beating a short time, the operator gets all the cocoons fastened, and, taking the bundle of threads, shakes the cocoons till each hangs by but a single one.

She now takes up five or more threads (*brins*), according to the quality of silk wanted, unites them, and introduces the combined staple or strand (*fil*) into a little glass eye on one side of the basin. She then forms a second similar strand and introduces

it into a second eye on the other side. The strands are then brought together, twisted several times, separated above the twist, and introduced into two other glass eyes or ringlets, through which they are led, one to each end of the reel or *tambour*, which is kept revolving in a steady, rapid manner, and to which is also given a certain back-and-forth side motion.

The great object in reeling is to get the threads uniform, rounded, well joined, properly freed from moisture, and so crossed on the reel that they will not stick or "glaze," as it is termed. These objects are attained by the twisting and the to-and-fro lateral movement of the reel, as also by properly regulating the distance between reel and basin.

The uniformity of the thread depends on the skill of the operator, who must supply a new thread as soon as one begins to give out. This is called nourishing the silk, and is done by dexterously casting with the thumb the new thread upon the combined strand, to which it immediately adheres. In this she must use much judgment, for the silk of a cocoon gradually gets lighter and finer as it approaches the end, and the uniformity of strand does not entirely depend on the uniformity in number of the individual threads forming it.

Whenever the silk rises in locks the temperature of the water is known to be too hot; and when it unwinds with difficulty the temperature is, on the contrary, too low.

The operator is supplied with a skimmer with which to remove all chrysalides and refuse silk; also, with a basin of cold water in which to cool her fingers, which are being constantly dipped in the hot basin.

This constitutes the whole operation of unwinding; but before the skeins, as they come from the reel, are ready for the manufacturer they must undergo still further manipulation.

The staple is first passed through a cleanser, consisting of a clasp lined with cloth, which catches any loose silk or other matter that may be adhering to it. It is then further cleansed and purged by being passed through four similar cleansers, then twisted about five hundred times to the yard, then doubled and again twisted about four hundred times to the yard. It is finally run on to reels about one and a half feet in diameter, and taken off and twisted in a hank.

Through all these operations the oscillating to-and-fro lateral motion is kept up, so as to produce the diagonal crossing of the strands; and it will be readily understood that each staple is in the end composed of several of the simple threads first spun by the worm.

The loose or floss silk, together with all that which, from one cause or another, can not be reeled, is soaked in water for three days, boiled for half an hour in clear lye, and washed in rain-water: when dry, it may be carded and spun.

Spun Silk.—Hon. John Ryle, of Paterson, N. J., the pioneer of silk-weaving in the United States, and who declares himself "an earnest advocate for the introduction of silk-culture," says:—

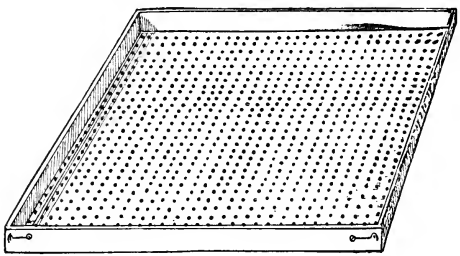
"We have all the requisite varieties of soil and climate to produce silk in great abundance, and with as little effort as it can be produced anywhere in the world. My views are not in accord with those of the parties at present engaged in attempting to reel silk,—believing, as I do, that it will be some time before we can attempt, with any prospect of success, to reel silk in America. My plan is to raise cocoons and sell them to the manufacturers of spun silk, and be content with that branch of silk-raising which produces the most money for the smallest amount of capital and labor."

IX.

SILK-CULTURE REQUISITES.

One may begin silk-culture without anything except trees and eggs. If one desire to enter into it as a permanent industry, or as amusement, and to secure out of it the highest profits and convenience, all or many of the following articles will facilitate operations:—

Bag Aprons, for gathering leaves, are simply large aprons in the form of a bag reaching from the waist to the feet.



TRAY AND COVERED FRAME.

Camel-hair Brushes for handling worms should be flat, and about one inch wide. See page 35.

Egg-boxes.—These must be made of perforated tin; and the perforations must be so small as to prevent the intrusion of any insect, and so numerous as to afford perfect ventilation.

Frames fit into the trays, and are made of strips of light wood, half an inch square, similar to slate-

frames, having a crossbar from side to side in the middle. Covered frames are the receptacles of food and feeding-places of the worms. See "Feeding," page 29.

Frame-Covers.—The most economical covers are made of tarlatan, mosquito-netting, and perforated paper. These cost but little: the first two can be cut and attached by any one, and the third can be bought very cheaply. They can be easily changed whenever they become soiled.

Hygrometer is an instrument to indicate the moisture of a room; and can rarely be had except in combination with a thermometer. But no well regulated cocoonery should be without it. A plate of salt may answer fairly as a substitute.

Leaf-cutters are kitchen chopping-knives, and have one, two, or three blades.

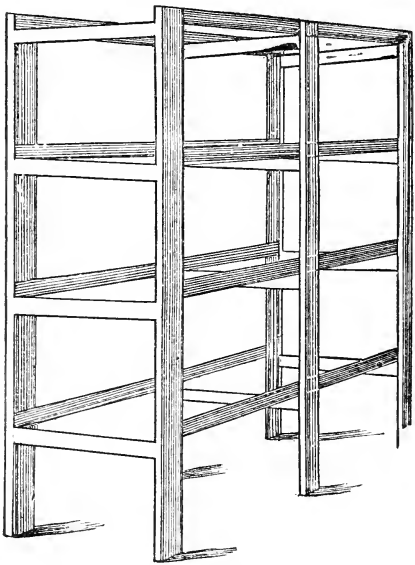
Magnifying Glasses are used for observing the worms, particularly in hatching and molting.

Mating-Boxes are one and a half by two feet, about an inch and a half deep, divided into compartments about two and a quarter inches square, and covered by a snugly fitting wire-screen lid. It is for keeping each couple of mated moths apart from others and undisturbed. See page 49.

Pruning-knives are knives with curved blades, such as gardeners use for pruning trees.

Shears are gardeners' shears, such as are used for trimming hedges.

Racks or Shelves.—Racks are better shelves; are cheaper. See page 21.



SINGLE RACK.

Sponges.—It is better to use a small sponge in cleaning the trays, and a large sponge for mopping up the floor of the cocoonery when the temperature is too high. See pages 23 and 24. When sponges are not easily obtained, use cloths and mops.

Stifiers.—These are for destroying the chrysalides. The best use steam or hot air. They can be had adapted to gas, kerosene, or common stoves.

When hot air alone is used care must be taken to prevent scorching of the cocoons.

United States Vice-Consul Griffitt, of Smyrna, in his report on "Silkworm Cultivation," of July 5, 1882, says: "The steaming process is far preferable to any other; the silk is not injured thereby, as it is apt to be by baking or exposure to the sun. I steam them twenty minutes, the water constantly boiling and this I find sufficient to destroy the chrysalides. I then place them in thin layers to dry."

Charcoal fumes are simple and effective. So are solar rays, intensified by glass covers. See page 43.

Thermometers are to indicate the temperature of the cocoonery. Any size will do.

Trays are shallow boxes about one and a half inches deep, one and a half feet wide and two feet long. They should be made of thin, well-seasoned, light, inodorous lumber. The bottom should be tongue-grooved and glued.

X.

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NEW YORK SILK EXCHANGE.

(Incorporated 1882).

To Silk Culturists.

The demand for Eggs, Trees and Seed is so large that it is impossible to guarantee sufficient supplies for next season unless you send us your orders immediately.

Orders must give New York City reference or be accompanied by cash, (postal order or check or registered letter.)

Cash orders have preference, and are guaranteed to be filled as soon as goods arrive in New York.

Orders giving reference will be advised upon receeipt of European invoices, of the amount required to cover said orders, and cash must be remitted upon receipt of such advice.

No goods shipped C. O. D.

EGGS.

We shall supply, unless otherwise ordered, the French (Pyrenean or Var or Cevennes) Annuals, warranted absolutely free from disease, being obtained through the Pasteur system.

The Pyrenean and Cevennes races are the hardiest, and best suited to the Middle, Eastern and Western States, having proved very successful in those States. These produce the large "peanut" shaped, straw-colored Cocoons.

They must be transported between Nov. 1st and March 31st—in some parts of the country as late as 1st of May.

To KEEP them till hatching time, place them in a cool cellar in a small tin box punctured with many small holes.

To HATCH them, bring them into a warmer place as soon as the Mulberry or Osage Orange trees begin to leaf out. They will hatch in one to four days.

To FEED and REAR them, see the "COMPLETE GUIDE TO SILK CULTURE," by L. Capsadell.

PRICE OF EGGS.

Best, imported, guaranteed, .	$4 per oz.; 25c. per 1000.
Best American, . .	$3.50 per oz.; 20c. per 1000.
Boxes for transporting and keeping eggs, each .	10 cts.

To those wanting to go into Silk Culture, but who have not the means, the Exchange will sell lands upon easy terms.

SILK-FOOD TREES.

Osage-Orange will produce silk and pay a fair profit. Use it if you have no other. But we advise—for higher profit—to acquire better food while you are learning to become expert in the culture.

The American White Mulberry is better. The large old trees of this variety yield cuttings which produce excellent food. Plant trees in fall 12 feet apart for nurseries, 4 to 6 feet apart if in a continuous row along the fence. They can be planted in hedges. Dwarf trees may be put 6 feet apart in good ground. Plant cuttings in spring; make cuttings 9 to 12 inches long, with 4 to 6 eyes; bury $\frac{2}{3}$ of each cutting, leaving 2 eyes out, 12 inches apart, in furrows 3 feet apart.

If you plant out 100 Morus Japonica, 8 to 10 feet high, in fall, they will feed half oz. of eggs (20,000 worms) next spring; and they will feed one oz. of eggs (40,000 worms) the succeeding spring. One oz. of Pyrenean eggs will give about 135 lbs. of cocoons. Meantime you can be increasing the orchard by cuttings and seedlings.

One acre will contain about 302 trees, set 12 feet apart each way.

PRICES OF MULBERRY TREES:

Cuttings of Alba, Rosea, and Moretti, per 100,	$ 0.90
Seedlings " " " 1 to 2 ft. high,	4.00
Trees, grafted, Moretti, 3 to 4 ft. high.	8.00
" Alba, Rosea, Moretti, 8 to 10 ft. high, .	28.00
" Japonica, 8 to 10 ft. high, ...	30.00

Cuttings and small trees can be sent by mail.

Postage packing and cartage extra.

NOTE.—*Morus Alba, Rosea, Moretti* and *Japonica* are the best silk producers; Japonica yields 1 lb. of silk to 10 lbs. of leaves, Alba, Rosea and Moretti yield each 1 lb. silk to 14 lbs. of leaves. France and Italy have discarded all other trees for Japonica.

PRICES OF MULBERRY SEED:

Morus Alba	$3.00 per lb.;	25 cts. per oz.	
" Rosea.....	4.00 "	35 cts.	"
" Moretti, ...	5.00 "	45 cts.	"

Seed in drills. Trees grown from seed should be grafted.

Silk Culture can be conducted profitably wherever any kind of Mulberry trees or Osage Orange will grow; and the best varieties will grow almost everywhere in the United States.

SILK CULTURE AS A HOME EMPLOYMENT.

There are thousands of women who are unable to labor in shop, field or factory, and have no means outside of their household duties of converting labor into capital.

There are thousands of others who are forced to live in idleness, or to go further, paint bad pictures, write poor sketches, drag their lives out teaching, or marry uncongenial husbands for the sake of a living. And there is a sentiment that it is a species of degradation to a young girl or woman to "go out" and work—but she will toil at home till her eyes grow dim.

Silk Culture, for all these people, is an easy money-making employment AT HOME, as it requires but a small amount of labor and capital, and is peculiarly adapted to the delicacy of skill and care which every woman naturally possesses.

HOW TO BEGIN SILK CULTURE.

No special buildings are required, as a room in the house, attic, stable or shed (with some care as to temperature and ventilation,) will do for a cocoonery, and after the Mulberry trees are planted an oz. or so of silk-worm eggs and a small book of instructions are all that are needed for a start.

Silk Culture does not interfere with domestic duties. Neither need the growing of trees interfere with the growing of vegetables, as the trimming system keeps the trees so dwarfed they throw but little shade, and will grow better by cultivating vegetables intermediately.

Use Osage Orange or the American White Mulberry, to begin, as these trees are ready grown in many parts of the United States; but plant out a few of the Morus *Alba*, or *Rosea, Moretti*, or *Japonica* at once, and increase the number from year to year until you can abandon the inferior plants.

Use nothing but the best Eggs, and acquire the best Trees as soon as you can.

YOU WILL NEED TO BEGIN :

About ½ oz. Eggs,.....say	$2 00
1 Tray and two frames (as models), ..about	1 25
You can make additional frames and trays as needed.	
Perforated paper for 20 frames,.....about	1 00
Lumber and nails for Racks or Stands to hold Trays, about	75
	$5 00

SILK CULTURE IS A PROFITABLE EMPLOYMENT.

In the lower Southern States three crops can be raised a season, two in the upper Southern States, and one in the Middle, Eastern and Northern States, each crop taking five to six weeks. Each crop will yield from $200 to $800 for every acre of land planted in Mulberry trees, according to the care and skill bestowed.

Trivoltins are required for three crops. *bivoltins* for two crops. These are Eastern or Japanese races, are more delicate and less silk productive than the Pyrenean race, which is an *annual*. The *annual* is the standard in France, where one certain large crop is considered better than two or three doubtful smaller ones.

Can any fruits or vegetables bring better returns,—or should any one go needy when such resources lie at the door?

It has also been demonstrated that silk raising will absolutely pay better with light labor than cotton or rice or sugar or tobacco with heavy labor.

PRICES OF REQUISITES:

Double Racks for 16 trays, each	$12.00
Single " 8 " "	9.00
1 Tray and 2 Frames, as models,	1.25
Floor and Tray Sponges, each	25c. and up
Tarlatan Frame covers, "	5c
Netting " " "	5c
Perforated paper, " "	5c
Boxes for shipping and preserving eggs, each	10c
Bag Aprons, each	50c
Camel-hair Brushes, all sizes	50c. and up
Pruning Knives, each	50c. to 1.50
Shears, "	90c. to 2.50
Leaf cutters, "	25c. and 50c
Thermometers, "	25c. and up
Thermometer and Hygrometer combined.,	4.00
Magnifying Glasses, 2 lenses....60c., 90c. and	1.25
" " 3 lenses.... 90c., 1.10 and	1.40
Mating Boxes, wooden bottoms, wire-gauze lids,	2.00
Patent Steam Stiflers No. 1, holding 8 lbs. Cocoons,	3.75
" " " No. 2, " 12 "	5.00
" " " No. 3, " 16 "	6.00
" " " No. 4, " 25 "	8.00

Cities and Towns may adorn their streets and parks with Mulberry, turn hovels into cocooneries, and make their poor, aged and infirm self-supporting and contented.

Clergymen may find recreation and profit in Silk Culture. The Mulberry makes beautiful shade trees for village and country churches, and will afford opportunity for pastors to improve the material, as well as the spiritual, condition of their parishioners.

Teachers can supplement their income greatly by raising Silk Worms during vacation. Prof. Jas. Johonnot is making Silk Culture a special topic of his Institute lectures before teachers thoughout the State of New York. He says that, as the schools generally (except in large cities) close early in spring, this vacation employment of six weeks will, in very many cases, pay more than all the winter's teaching.

Taxation is reduced by whatever increases national wealth. National wealth is simply individual prosperity. Silk Culture is the only industry applicable to every individual. It brings money to the humblest "hewer of wood and drawer of water," the farmer's wife and daughter, the brown-armed son of toil, teacher, scientist, clergyman, alike. It is peculiarly *The People's Industry.*

Nationally, it is estimated that there were 25,000 people engaged in Silk Culture in the U. S. last year, and 50,000 will be engaged in it next year; and that, supposing our 50,000,000 population comprises 10,000,000 producers, Silk Culture may transfer (women, children and old men,) 10,000,000 from non-producers to producers. Whatever doubles the producing power of a nation doubles its wealth. Silk Culture enabled France to discharge a war debt quicker than so large a debt was ever paid by any other nation.

Years ago Silk Culture was attempted in this country and much money was lost because there were no mills to consume the silk. Now there are 380 silk mills in the United States. Two-thirds of the raw silk which they use is imported, for which *thirty-five million dollars* are annually sent abroad. Silk Culture can retain all this money at home and put it at once into the pockets of farmers' wives.

There is no reason why the entire demand of the mills should not be supplied by cocoons produced here.

SUGGESTIONS TO SILK-CULTURISTS.

Charlatans.—Some unprincipled parties and so-called "associations" and "companies," taking advantage of the novelty and newness of the industry and its undefined prices have been charging for Eggs, $40 per oz. or $1 per 1000, and even as high as $160 per oz. or 40c. per 100! And similar prices for trees and requisites! Such prices are exorbitant and extortionate. Compare them with our quotations. Such outrages should occur no more.

How to Increase the Profits.—The experience of France, Italy, Japan, China, etc., should be applied here with watchfulness. The precise processes of one country will not apply in detail to any other country. We have in the United States newer lands, more primitive soil, more varied climates, and purer atmospheres—the chemical qualities of life with less vitiation—than any other Silk producing country. THE EXCHANGE requests Silk culturists to note their experiments and results and report same, however simple they may appear. It will gladly record, tabulate and distribute all such data, rapidly and freely. Thus the Silk culturists of the United States may make swift and profitable advances over the older Silk countries. The United States brought cotton culture to its highest profits. Why not advance Silk culture? What we know of it assures large profits. Let us learn more and acquire *larger* profits—and in the American way—quickly.

The Press.—While realizing that the recent and repeated references to Silk culture by the newspaper press are in the public interest, the SILK EXCHANGE thanks Editors none the less for presenting the topic so fully, and especially for the uniform courtesy and kindness which it has received at their hands. Neither Silk culture nor any other culture can advance in a Republic like ours without the approval and encouragement of the press, and the SILK EXCHANGE respectfully solicits the attention of Editors and the co-operation of every periodical in the United States in behalf of this *New Industry for the People.*

The Silk Exchange, in acknowledging the practical encouragement which it is daily receiving, assures it patrons that it is pushing its connections and establishing agencies in the United States, France, Italy, Japan, China, etc., with all possible speed, and will meet every demand of the export and import trade of *Silk Culture.*

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By L. CAPSADELL, *Sec. N. Y. Silk Exchange.*

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